International Journal of Humanities
and Social Sciences (IJHSS)
ISSN 2319-393X
Vol. 2, Issue 4, Sep 2013, 1-6

SKINPUT

BHAGYA PAREKH[1], NAINEEL SHAH[2], RUSHABH MEHTA[3] & TUSHAR SAWANT[4]

[1,2,3]B.E. Student (EXTC), D.J. Sanghvi College, Mumbai, Maharashtra, India

[4]M.E. Student (EXTC), D.J. Sanghvi College, Mumbai, Maharashtra, India

ABSTRACT

Skinput is a technology which uses the surface of the skin as an input device. Our skin produces natural and distinct mechanical vibrations when tapped at different places. Vibration sensors such as Piezo Film Elements are employed to detect these mechanical vibrations. When augmented with a pico-projector the device produces a graphical user interface on our skin. This technology provides an always available and convenient input surface. This also makes it possible to design devices in a way to reduce its size which in turn helps in power conservation without sacrificing on the surface area of the input.

KEYWORDS: Skinput, Bio-Acoustics, on-Body Interaction, Audio Interface, ATmega168

INTRODUCTION

The main motivation beh1ind designing such a device is to keep an electronic gadget as small as possible without compromising on the size of the input surface. This essentially means that the size of the input surface is independent of the electronic device. Appropriating the human body as an input device is appealing not only because we have roughly two square meters of external surface area, but also because much of it is easily accessible by our hands (e.g., arms, upper legs, torso). Furthermore, proprioception – our sense of how our body is configured in three-dimensional space – allows us to accurately interact with our bodies in an eyes-free manner. Few external input devices can claim this accurate, eyes-free input characteristic and provide such a large interaction area[1]. Skinput uses the concept of Bio-Acoustics.

PRINCIPLE

The principle on which this technology works is bio-acoustics. Whenever there is a disturbance on the surface of the skin, acoustic energy is produced. Some amount of this energy is lost to the external environment in the form of sound waves[5]. A part of the rest of the energy travels along the surface of the skin and the rest is transmitted inwards till it gets reflected from the bone. Depending on the type of surface on which the disturbance is created, the amplitude of the wave varies. For example, on a soft surface (forearm) the amplitude is larger as compared to a hard surface (elbow) where the amplitude is smaller. In addition to the underneath surface, the amplitude of the wave also varies with the force of disturbance.

The 2 kinds of waves developed on the surface are transverse waves and longitudinal waves. The waves that are transmitted along the surface of our skin are transverse waves. While longitudinal waves are transmitted into the body towards the skeleton. The disturbance causes the transverse wave to move along the skin till it reaches the sensor. This sensor senses the amplitude of the disturbance. Unlike the effect of transverse waves on soft tissues, the longitudinal waves travel inwards towards the bone which is much less deformable. The bone responds to the mechanical stimulus like any other rigid body would, by rotating and translating.

The main reason why we need to study the effect of both these waves separately is because both of them carry

energy at different frequencies and across different distances. Energy conduction through the bone happens more readily as compared to that of soft tissues at higher frequencies. The final acoustic pattern is due to longitudinal and transverse waves.

Joints in our body play an important role by acting as acoustic filters as they are fluid cavities. Joints perform either of the following 2 functions. They can dampen the acoustics acting as dampeners or even attenuate certain frequencies from the acoustics acting as a frequency selective device.

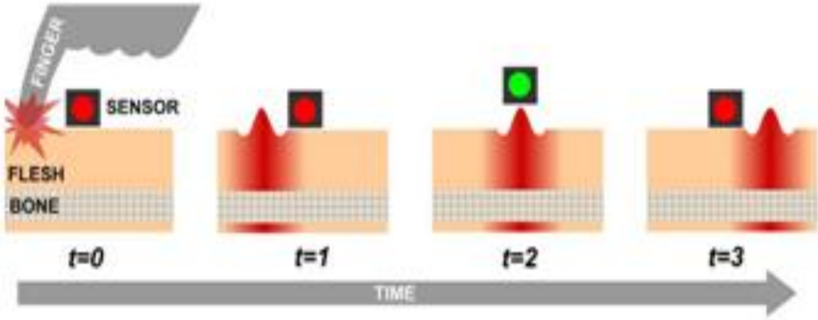

Figure 1: Transverse Wave Propagation: Finger Impacts Displace the Skin, Creating Transverse Waves (Ripples). The Sensor is Activated as the Wave Passes Underneath it

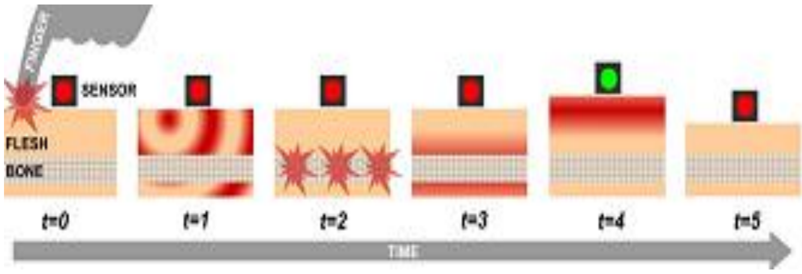

Figure 2: Longitudinal Wave Propagation: Finger Impacts Create Longitudinal (Compressive) Waves that Cause Internal Skeletal Structures to Vibrate. This, in Turn, Creates Longitudinal Waves that Emanate Outwards from the Bone (Along its Entire Length) Toward the Skin

WORKING

In the prototype, a Mackie Onyx 1200F audio interface was employed to digitally capture data from the sensors, which was connected via Firewire to a conventional desktop computer. Now each channel of the input was sampled at a sampling frequency of 5.5KHz. This sampling frequency is too low for speech or environmental audio, but is able to represent the spectrum of the frequencies transmitted through the arm as a result of the touch or tap inputs.

Also another advantage of the low sampling frequency is that it makes the technique readily portable to embedded processors. For example, the ATmega168 processor employed by the Arduino platform can sample analog readings at 77kHz with no loss of precision, and could therefore provide the full sampling power required for *Skinput* (55kHz total).

The program performs three important functions. (1) It provides a live visual of the data from the sensors. (2) It segments and separates inputs from the data stream into independent instances. (3) It classifies these instances separately.

Now for the above mentioned 3 operations, a threshold value was decided. When the intensity of the input exceeded this threshold value the program recorded the timestamp as a potential start of a tap. Now if the intensity did not fall below another lower threshold value within the time range of 100ms and 700ms, the event of tap input was discarded. However if the start and end crossings were satisfied, the input event was considered.[2]

After the inputs have been segmented and separated, the waveforms are analyzed. Owing to the highly discrete nature of taps, the inputs were short-lived and an approach computing 186 features in total was employed. For computing and analyzing the gross information, the average amplitude, standard deviation and total energy of each waveform was included. From these, the ratios of the average amplitudes between the waveform pairs were calculated and an average of these ratios was included.

Then a 256-point FFT for the input channels was calculated and these were normalized by the highest amplitude FFT value found. When using Skinput to recognize live input, the 186 acoustic features are computed on the fly for each segmented input. These are then fed into the trained SVM for classification. Once an input is classified an event associated with that particular location on the input surface is initiated.

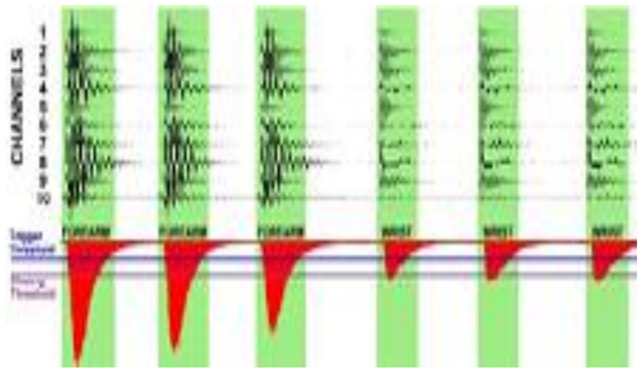

Figure 3: Ten Channels of Acoustic Data Generated by Three Finger Taps on the Forearm Followed by 3 Taps on the Wrist. The Exponential Average of the Channels is Shown in Red. Segmented Input Windows are Highlighted in Green. Note How Different Sensing Elements are Actuated by the Two Locations

IMPLEMENTATION

Skinput is yet in its nurturing stage but when fully developed it can be used as an input for almost any electronic device. This is mainly due to it’s user friendly approach. It's fairly simple to associate tappable areas with different commands in an interface, just as different keystrokes and mouse clicks perform different functions on a computer.[3]

Through skinput we can play games with just the movement of our hands. This will introduce a totally new era of gaming.

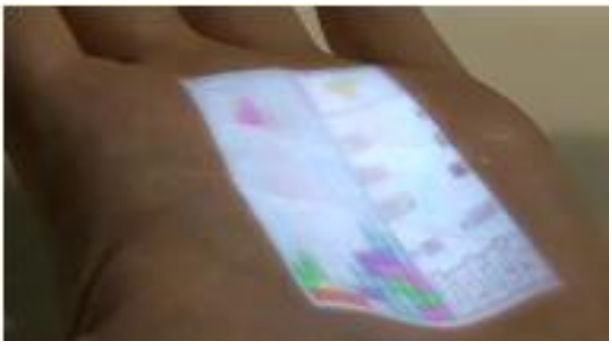

Figure 4: Tetris Being Played Using Skinput

We can operate any electronic device without actually holding it. This enables us to easily multitask because the surface of input can be much larger than that of the electronic device.

We can turn our arm into a cellphone. It will be possible to make calls by just typing numbers that flash on your forearm[6]. All other functions can also be performed using skinput. We can also increase or decrease the volume or change the track of our music players like the i-pod without actually touching the gadget.

Figure 5: Making a Phone Call Using Skinput

If this gadget ever becomes a commercial reality, it could redefine our perception of common gestures. Drumming your fingers nervously could actually be texting, for example, while a slap to the forehead could launch a Web browser. Extrapolating from the arm device, I'll bet Skinput could turn the whole body into one giant quivering, jumping, dancing interface. [4]

Figure 6: Controlling Music Player Applications Using Skinput

ADVANTAGES

- The projected interface can appear much larger than it ever could on a device's screen.
- Arm can be brought closer to face (or vice versa) to see the display close up.
- Reduction in size of future electronic gadgets.
- Skinput could eventually be used without a visual screen. This will make it ideal for anyone with no eyesight.
- The body is portable and always available, and fingers are a natural input device.
- Colour contrast can be adjusted by dimming the light so that a better picture will be visible if skin and text are too similar in colour during daylight.

FEASIBILITY

- It is a relatively inexpensive technology.
- It can be manufactured in a very small form factor, rendering it suitable for inclusion in future mobile devices.
- It can be used in a large variety of electronic devices.

CONSTRAINTS

- A person's BMI (body mass index) plays a major role in the accuracy of skinput. , the prevalence of fatty tissues and the density/mass of bones tend to dampen or facilitate the transmission of acoustic energy in the body. Hence, higher the BMI, lower is the accuracy and vice versa.

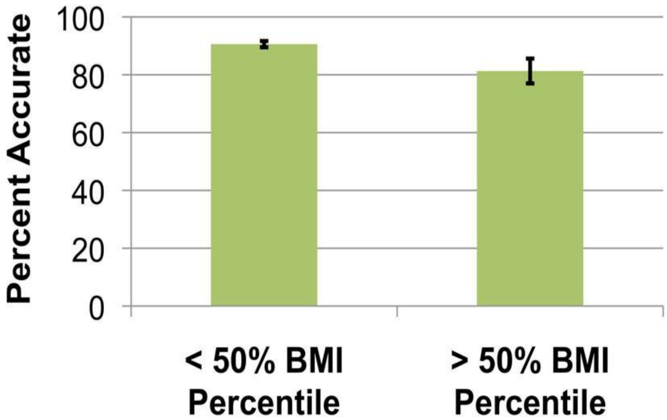

Figure 7: Accuracy is Significantly Lower for BMI'S Lower than the 50th Percentile

- Skinput can prove to be inconvenient in crowded areas. A random touch on the interface can be sensed and causes actions which are not desired for example it can result in a random call to someone. This constraint has been successfully overcome by setting a threshold. Till the tap doesn't cross the set threshold, the input is not sensed. Also, the tap should last for a sufficiently long interval of time. This will avoid any random tap from being sensed and thus will not cause an undesired action.

FUTURE SCOPE

The armband used currently is very bulky. It is very unlikely that a person would want to carry the armband around throughout the day. In the future, the size of the armband will be reduced considerably such that the user will not even realize that he is wearing the armband[7]. Also, the multi-sensor armband will be wireless, allowing the exploration of a wide variety of usage scenarios.

The next generation of miniature projectors will be small enough to fit in a wrist watch, making skinput a complete and portable system that could be hooked up to any compatible electronics no matter where the user goes. Biometric input devices can provide assistive technology access to people who have little or no motor control. Thus we can determine skinput's effectiveness as a non-muscular channel of input. Using skinput, the need of game controllers will become almost redundant. Hence in the future, games will be played without physical controls.

CONCLUSIONS

In this paper we have presented a way in which we can use our skin as an input surface. This is a great technology and has immense scope in the future. We have illustrated in detail the principle and explained how skinput practically works. We have also stated its implementations by in which it can be seen that this technology will soon revolutionize the concept of 'input device' in the future.

ACKNOWLEDGEMENTS

Every project is a cumulation of the hard work put in by many. Our project is also not different in this respect. So we hereby take this opportunity to thank all the professors and others who helped in making this project successful.

REFERENCES

1. Goode, Lauren (26 April 2010). "The Skinny on Touch Technology". *Wall Street Journal*.
2. Harrison, Chris; Tan, Desney; Morris, Dan (10-15 April 2010). "Skinput: Appropriating the Body as an Input Surface".
3. Hope, Dan. "‘Skinput’ turns body into touchscreen interface".
4. Hornyak, Tom. "Turn your arm into a phone with Skinput.
5. Deyle, T., Palinko, S., Poole, E.S., and Starner, T. Hambone: A Bio-Acoustic Gesture Interface.
6. Saponas, T.S., Tan, D.S., Morris, D., and Balakrishnan, R. Demonstrating the feasibility of using forearm electromyography for muscle-computer interfaces.
7. Mistry, P., Maes, P., and Chang, L. WUW - wear Ur world: a wearable gestural interface.
8. Moore, M., and Dua, U. A galvanic skin response interface for people with severe motor disabilities.